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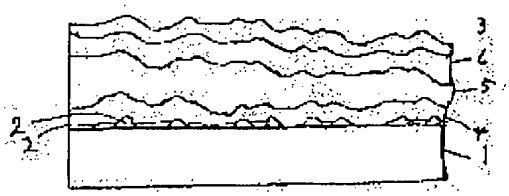
(54) MANUFACTURE OF MAGNETIC RECORDING MEDIUM HAVING RUGGEDNESS ON SURFACE

(57)Abstract:
PURPOSE: To improve contact start-stop characteristics of a magnetic recording medium by heating a continuous thin film consisting of at least two metals having an eutectic point and subjecting it to phase-separation and aggregation to form a ruggedly formed body.
CONSTITUTION: In this manufacturing method, an AlGe film is formed on a glass substrate 1 by using a sputtering target consisting of Al as the major component and Ge or Mg as the minor component. Then, the substrate 1 is heated to a prescribed temp. to form the ruggedly formed body 2 consisting of Al and Ge which are subjected to aggregation associated with phase separation. Subsequently, the Ti undercoat layer 4, Cr undercoat layer 5, magnetic layer 6 and protective layer 3 are successively formed on the ruggedly formed body 2. Thus, ruggedness due to the ruggedly formed body 2 is formed on the surface of the protective layer 3 to manufacture the objective magnetic recording medium excellent in friction/sliding characteristics and characteristics with respect to the low floating height between the medium and the magnetic head.



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CLAIMS

[Claim(s)]
[Claim 1] In the approach of forming the toothing product for giving irregularity to a protective layer front face on a nonmagnetic substrate, carrying out sequential formation of a substrate layer, a magnetic layer, and the protective layer after that, and manufacturing a magnetic-recording medium The manufacture approach of a magnetic-recording medium characterized by the thing which is done with heating for the separation condensation of the continuation thin film which covers the continuation thin film which consists said toothing product of two or more sorts of metals which have (a) eutectic point on a nonmagnetic substrate, and consists of said metal after that [(b)], and which form especially more of having the shape of toothing on a front face.
[Claim 2] The manufacture approach of a magnetic-recording medium of having the shape of toothing on the front face according to claim 1 whose eutectic point which the system of said metal builds is 500 degrees C or less.
[Claim 3] The manufacture approach of a magnetic-recording medium of having the shape of toothing on the front face according to claim 1 or 2 characterized by for the principal component of said metal being aluminum and being at least one sort chosen from the metal group which other components become from germanium and Mg.
[Claim 4] 20-40 atom % Said metal consists of aluminum and germanium and germanium is the manufacture approach of a magnetic-recording medium of having the shape of toothing on a front face given in claim 1 characterized by being contained thru/or one term of 3.
[Claim 5] The manufacture approach of a magnetic-recording medium of having the shape of toothing on the front face according to claim 1 to 3 characterized by preceding forming said toothing product and preparing the layer which decreases the surface energy of a nonmagnetic substrate on a nonmagnetic substrate.
[Claim 6] The manufacture approach of a magnetic-recording medium of having the shape of toothing on the front face according to claim 5 characterized by making into the alloy layer of titanium and chromium the layer which decreases said surface energy.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] About the manufacture approach of the magnetic-recording medium used for a magnetic recording medium, when this invention is explained further in full detail, it relates to the manufacture approach of the magnetic-recording medium whose friction sliding property with the magnetic head improved.
[0002]
[Description of the Prior Art] The magnetic head contacts a magnetic disk at the time of a halt of a magnetic-recording medium (magnetic disk), in early stages of the startup, the magnetic head slides on a magnetic-disk top, after it, a magnetic disk is left, it rises to surface, and many so-called CSS (contact start stop) methods of flying in fixed distance are adopted by the hard disk drive which has spread as recording apparatus, such as a current computer. In order to lower coefficient of friction of the magnetic head and a magnetic disk at this time, forming detailed irregularity in a magnetic-disk front face is performed. While this detailed irregularity fully lowers coefficient of friction, when the magnetic head is in a flight condition, it is required that this irregularity should not be collided with. Conventionally, the approach of pressing a polish abrasive grain etc. and forming a crack at a circumferencial direction on the rotating nonmagnetic substrate, was carried out to formation of this detailed irregularity. moreover, that of the magnetic head -- low -- the approach of forming surface irregularity is proposed by heating a nonmagnetic substrate, for example, and covering low-melt point point metal thin films, such as aluminum, with the magnetic disk of which a flight [****] is required so that island-shape structure may be formed (JP,3-73419,A). Moreover, after forming a metal thin film on a nonmagnetic substrate front face, it is made the film which heats and consists of a detailed condensation grain, and the approach of forming surface irregularity is proposed (JP,5-85773,A). The approach which the melting point covers and furthermore makes liquid drop-like metal particles on the substrate which heated the low-melt point point metal 350 degrees C or less more than the melting point is proposed (JP,5-282648,A).
[0003]
[Problem(s) to be Solved by the Invention] However, there is no brittleness of glass, the ceramics, etc., there was a trouble that a substrate tends to be missing, with a substrate with a big degree of hardness by the approach of forming a crack in a circumferencial direction with the polish abrasive grain of the conventional technique, and the shape of the surface toothing could not be controlled to a precision, but fulfilling both a CSS property and the low surfacing property of the magnetic head to coincidence had the trouble of being very difficult.
[0004] Moreover, by the approach of forming the toothing product of island-shape structure on the substrate heated by the elevated temperature mentioned above, the magnitude and the period of the surface irregularity were small, and since distribution of the height of heights gathered too much, coefficient of friction did not become so small, but the CSS property had the trouble that it was not necessarily satisfactory. Moreover, in order to make such island-shape structure form, the substrate temperature at the time of membrane formation had to be held to quite high temperature, and there were troubles, like the fall of substrate temperature until it reaches [from a substrate heating zone] a membrane formation zone in the membrane formation equipment of a substrate conveyance mold especially with high productivity, and the temperature distribution in a substrate worsen. This invention is made in order to solve such a trouble.
[0005]

[Means for Solving the Problem] In the approach of this invention forming the toothing product for giving irregularity to a protective layer front face on a nonmagnetic substrate, carrying out sequential formation of a substrate layer, a magnetic layer, and the protective layer after that, and manufacturing a magnetic-recording medium It is the manufacture approach of a magnetic-recording medium of carrying out the separation condensation of the continuation thin film which covers the continuation thin film which consists said toothing product of two or more sorts of metals which have (a) eutectic point on a nonmagnetic substrate, and consists of said metal after that [(b)] with heating and of having the shape of toothing on the front face formed especially more.

[0006] Make phase separation start in the condition that it will be in a melting condition with loose association between the atom when the thin film of the multicomponent metal of the eutectic system which has the eutectic point when this invention is low is heat more than it the melting point and near the eutectic point , and the configuration can change easily , and it is characterize by a flat thin film with the large rate of an interface and surface energy to the thing with the more small rate of an interface and surface energy make to condense liquid drop-like in the whole condition energy . And the more the thickness of the thin film of the initial stage before heating the metal thin film which continued in the direction parallel to the front face of a nonmagnetic substrate is thin, since the interface in the inside of the whole and the rate of surface energy are large, the more a melting condition and a condensation process may happen at temperature (they are specifically 1 / about two to 2/3 temperature at the absolute temperature of the melting point of bulk) quite lower than the melting point or the eutectic point in a condition of bulk. Moreover, it is more desirable to be the continuation film with which an early thin film does not serve as the so-called island-shape structure from a viewpoint which enlarges the rate of this front face and surface energy. Such a continuation metal membrane can be obtained by forming membranes by whenever [room temperature / which is not compulsorily formed for example, heated at low substrate temperature].

[0007] Although about 5-10nm of aluminum whose melting point in a bulk condition is 660 degrees C was formed to the soda lime glass substrate of a room temperature as a metal membrane to be used and this was heated to 450 degrees C, the toothing product (texture) which has the shape of surface type required to form the surface irregularity of a magnetic disk was not able to be formed. Since there is a danger of being accompanied by deformation of a glass substrate and the gas evolution from a substrate front face increases, whenever [beyond this / stoving temperature] is not desirable, considering the viewpoint of practical use production.

[0008] On the other hand, if it is near [the] the eutectic-point presentation in the alloy of the two-component system which has the eutectic point, or the system of three or more components, it is known well that the melting point will become low far rather than the melting point of the metal simple substance of each component. For example, although the melting points in the bulk of each simple substance of aluminum and germanium are 660 degrees C and 936 degrees C, respectively, in the eutectic point (aluminum:germanium=71.6:28.4, atomic % ratio), the melting point becomes low to about 420 degrees C. Then, each component which has the presentation such near the eutectic point was mixed enough microscopically, for example, continuation film which is amorphous is formed, and if this is heated, melting and condensation will occur. And the phase separation of each eutectic system component occurs in a condensation process and coincidence in this case at coincidence.

[0009] Since melting and condensation are made to cause at the temperature in which the nonmagnetic substrate of the float glass of a soda lime silica presentation for example, does not carry out softening deformation, it is desirable to choose an alloy system so that the eutectic point of an alloy may become 500 degrees C or less. The temperature of the eutectic point is 500 degrees C or less, and since the condensation produced by moreover heating the continuation film of those metals occurs with presentation-phase separation, the metal system of the multicomponent system which contains the two-component system of aluminum-germanium and aluminum-Mg or them which set a basis metal to aluminum especially is desirable. In this invention, the system which uses aluminum as a principal component and uses

germanium or Mg as an accessory constituent is desirable, and it is desirable that aluminum of a principal component covers the continuation film which 60 to 80 atom % and an accessory constituent 20-40 atom % Contain.
[0010] As for whenever [stoving temperature / of the continuation thin film concerning this invention], it is desirable to make it higher than temperature lower 150 degrees C than the eutectic temperature which is the temperature of the eutectic point, when making condensation cause for a short time. In this invention, it is desirable to set thickness of a metal thin film to 4-20nm, and to set the height of a toothing product to 25-100nm by the afterbaking.
[0011] Furthermore, when a nonmagnetic substrate is a glass substrate, in order to precede forming a toothing product and to adjust the state of aggregation of a toothing product, the layer which decreases the surface energy of a substrate can be prepared. As a layer which decreases this surface energy, the layer of Ti or a Ti-Cr alloy is used preferably.
[0012]
[Function] By being heated more than the eutectic point of the system, and being cooled, the metal coat which continued in the direction of a substrate side which consists of a metal of two or more components concerning this invention is condensed with phase separation, and becomes the toothing product of the configuration discretely arranged on a substrate from the continuation film. As for the protective layer front face of a magnetic-recording medium, in response to effect, irregularity is formed in the shape of [of this toothing product] surface type.

[0013]
[Example] Hereafter, an example explains this invention to a detail. drawing 1 and drawing 2 -- a part of example of this invention -- it is a sectional view (expressed typically). The toothing product 2 which consists of aluminum and germanium is formed on a glass substrate 1, and, as for drawing 1 , the irregularity to which Ti substrate layer 4, Cr substrate layer 5, a magnetic layer 6, and a protective layer 3 are formed, and originate in the toothing product 2 in the front face of a protective layer 3 is formed on it. Other examples are sectional views (expressed typically) a part, drawing 2 precedes forming the toothing product 2 on a glass substrate, and the layer 7 for decreasing surface energy is formed on the glass substrate 1. Drawing 3 is drawing obtained from the electron microscope photograph for explaining the configuration of the toothing product concerning this invention.
[0014] aluminum71.6germanium28.4 (atomic %) was used as the sputtering target at the glass substrate (that by which was processed disc-like and the chemical strengthening was carried out) 1 of a soda lime silica presentation of the room temperature condition washed with the sufficient example 1, and about 10nm of AlGe film 2 was formed by the DC magnetron sputtering method using an argon. Next, after holding this substrate for 3 minutes within the same vacuum tub just before the heater held at 350 degrees C, it took out outside. The obtained substrate front face was observed with the scanning electron microscope. The shape of the surface type is typically shown in drawing 3 . The AlGe film (shown in [A] drawing 3) divided into island shape with heating is covered on the glass substrate front face (shown in [B] drawing 3), and the liquid drop-like floc to which magnitude with a 200nm height [of ****] of about 50nm was fully dispersed was formed in the periphery section of the AlGe film divided into island shape.
[0015] aluminum71.6germanium28.4 (atomic %) was used as the sputtering target at the glass substrate (thing which was processed disc-like and by which the chemical strengthening was carried out) 1 of a soda lime silica presentation of the room temperature condition washed with the sufficient example 2, and about 5nm of AlGe film 2 was formed by the DC sputtering method using argon gas. Within the same vacuum tub, next, this substrate It holds for 3 minutes in front of the heater held at 350 degrees C, and 30nm of Ti film is formed using a titanium target by the same approach after this, and it holds for 3 minutes in front of the heater held at 350 more degrees C. After this Cr film, the CoNiCr film, and the carbon film, respectively 120nm, 56nm, In thickness of 20nm, all the processes more than . which used chromium, a cobalt nickel chrome alloy, and carbon for the target, and carried out sequential membrane formation took out . performed without breaking a vacuum within the same vacuum tub, next this substrate, applied about 3nm of fluid lubrication agents, and obtained the magnetic disk. The mimetic diagram of

the cross-section structure of this magnetic disk is shown in drawing 2 . When the surface irregularity of this magnetic disk is measured with a scanning tunneling microscope, with a film configuration which is about 4.5nm by that average of roughness height, and was described in the top It compares with the value (2.0nm) at the time of simply not forming the AlGe film. When the surfacing property on . by which it was checked that surface irregularity is formed certainly, next this magnetic disk of the magnetic head is investigated, to 62nm When this magnetic disk is covered over a CSS trial at the . last carrying out surfacing transit turned out to be at stability using the micro slider which set the head load to 6.5g, without ********** colliding with the projection on a magnetic disk, 20,000 times of coefficients of friction of rest 0.6, About 0.5 dynamic friction coefficient and the very good friction sliding property were shown.

[0016] Ti film which contains Cr of 45 atom % on the glass substrate of the soda lime silica presentation washed with the sufficient example 3 is continued 20nm and on it. 10nm aluminum71.6germanium28.4 . formed by the DC magnetron sputtering method, next this substrate It holds for 3 minutes in front of the heater held at 300 degrees C, and about 30nm of Ti film is formed by the same approach after this, and it holds for 3 minutes in front of the heater held at 350 more degrees C. After this Cr film, the CoNiCr film, and the carbon film, respectively 120nm, 56nm, Sequential membrane formation was carried out by the thickness of 20nm. All the above processes took out . performed without breaking a vacuum within the same vacuum tub, next this substrate, applied about 3nm of fluid lubrication agents, and obtained the magnetic disk. a part of this magnetic disk -- a sectional view is shown in drawing 3 . When the surface irregularity of this magnetic disk was measured with the scanning tunneling microscope, it was set to about 6.0nm by that average of roughness height. Next, when the surfacing property on this substrate of the magnetic head was investigated, it turned out at stability to 70nm that surfacing transit is carried out, without the magnetic head colliding with the projection on a magnetic disk. When this magnetic disk was covered over the CSS trial at the last using the micro slider which set the head load to 6.5g, 20,000 times of coefficients of friction of rest showed 0.4, about 0.3 dynamic friction coefficient, and the very good friction sliding property.

[0017] aluminum33Zn67 (atomic %) was used as the sputtering target at the glass substrate (thing which was processed disc-like and by which the chemical strengthening was carried out) of a soda lime silica presentation of the room temperature condition washed with the sufficient example 4, and about 5nm of AlZn film was formed by the DC magnetron sputtering method using argon gas. This substrate is held for 3 minutes in front of the heater held at 350 degrees C within the same vacuum tub, and about 30nm of Ti film is formed by the same approach after this, and it holds for 3 minutes in front of the heater held at 350 more degrees C. After this Cr film, the CoNiCr film, and the carbon film, respectively Next, 120nm, All the processes more than . which carried out sequential membrane formation by the thickness of 56nm and 20nm took out . performed without breaking a vacuum within the same vacuum tub, next this substrate, applied about 3nm of fluid lubrication agents, and obtained the magnetic disk. When the surfacing property on . by which it was checked that are about 4.5nm by that average of roughness height, and surface irregularity is certainly formed when the surface irregularity of this magnetic disk is measured with a scanning tunneling microscope, next this substrate of the magnetic head is investigated, to 50nm When this magnetic disk is covered over a CSS trial at the . last carrying out surfacing transit turned out to be at stability using the micro slider which set the head load to 6.5g, without ********** colliding with the projection on a magnetic disk, 20,000 times of coefficients of friction of rest 0.7, About 0.6 dynamic friction coefficient and the very good friction sliding property were shown.

[Effect of the Invention] According to this invention, the process of thin film formation and heating can perform the shape of toothing required to obtain the magnetic-recording medium excellent in a friction sliding property and a low surfacing property with the magnetic head of the front face of a magnetic-recording medium on a nonmagnetic substrate front face continuously with formation of the substrate layer performed after that, a magnetic layer, and a protective layer.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] a part of one example of the magnetic disk obtained by this invention -- it is a sectional view.
[Drawing 2] a part of other examples of the magnetic disk obtained by this invention -- it is a sectional view.
[Drawing 3] In order to explain the shape of surface type of the aluminum-germanium system irregularity constituent of the example 1 of this invention, it is drawing obtained from the scanning electron microscope photograph.
[Description of Notations]
1 [... Ti layer, 5 / ... A substrate layer, 6 / ... A magnetic layer, 7 / ... Layer which decreases surface energy] ... A glass substrate, 2 ... A toothing product, 3 ... A protective layer, 4

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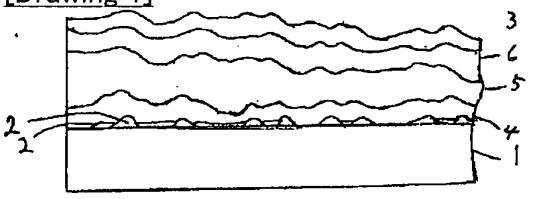
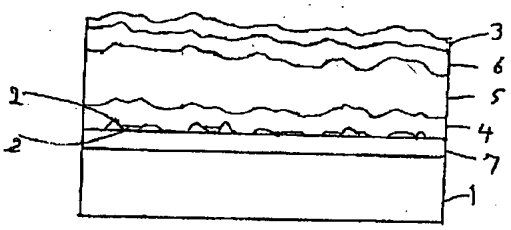
DRAWINGS

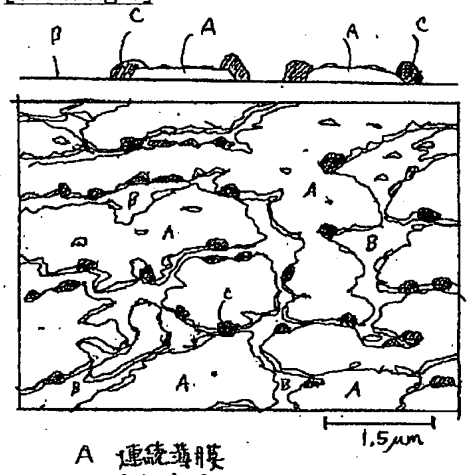
[Drawing 1]



[Drawing 2]



[Drawing 3]



A 連続薄膜
B 基板表面
C 液滴状凝集体

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WRITTEN AMENDMENT

---------- [a procedure revision]
[Filing Date] March 18, Heisei 6
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] 0017
[Method of Amendment] Modification
[Proposed Amendment]
[0017] Example 4
aluminum60Mg40 (atomic %) was used as the sputtering target at the glass substrate (thing which was processed disc-like and by which the chemical strengthening was carried out) of a

soda lime silica presentation of the room temperature condition washed well, and about 5nm of AlMg film was formed by the DC magnetron sputtering method using argon gas. This substrate is held for 3 minutes in front of the heater held at 350 degrees C within the same vacuum tub, and about 30nm of Ti film is formed by the same approach after this, and it holds for 3 minutes in front of the heater held at 350 more degrees C. After this Cr film, the CoNiCr film, and the carbon film, respectively Next, 120nm, All the processes more than . which carried out sequential membrane formation by the thickness of 56nm and 20nm took out . performed without breaking a vacuum within the same vacuum tub, next this substrate, applied about 3nm of fluid lubrication agents, and obtained the magnetic disk. When the surfacing property on . by which it was checked that are about 4.5nm by that average of roughness height, and surface irregularity is certainly formed when the surface irregularity of this magnetic disk is measured with a scanning tunneling microscope, next this substrate of the magnetic head is investigated, to 50nm When this magnetic disk is covered over a CSS trial at the . last carrying out surfacing transit turned out to be at stability using the micro slider which set the head load to 6.5g, without ********** colliding with the projection on a magnetic disk, 20,000 times of coefficients of friction of rest 0.7, About 0.6 dynamic friction coefficient and the very good friction sliding property were shown.

[Translation done.]

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	5/82				

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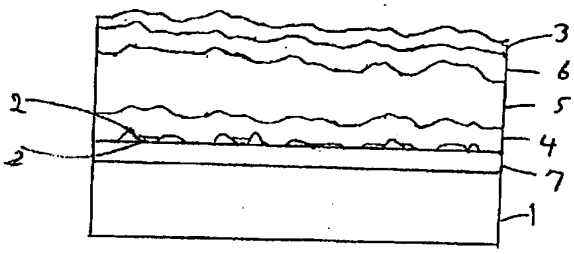
(54)【発明の名称】　表面に凹凸形状を有する磁気記録媒体の製造方法

(57)【要約】

【目的】コンタクトスタートストップ特性を良くする表面凹凸形状を有する磁気記録媒体の製造方法を提供すること。

【構成】ガラス板上にアルミニウムとゲルマニウムを含むターゲットを用いて、連続した金属被膜を被覆し、その後被膜を金属の共晶点以上に加熱して溶融し、その後冷却して連続被膜を凝集して離散的な凹凸形成物とし、その後クロム下地膜、コバルト合金磁性膜、カーボン保護膜を被覆する。上記の膜は、いずれもスパッタリング法で被覆される。凹凸形成物の金属系としてはＡｌ－Ｇｅ，Ａｌ－Ｍｇが好んで用いられる。



【特許請求の範囲】
【請求項１】保護層表面に凹凸を付与するための凹凸形成物を非磁性基板上に形成し、その後下地層、磁性層、保護層を順次形成して磁気記録媒体を製造する方法において、前記凹凸形成物を、（ａ）共晶点を有する２種以上の金属からなる連続薄膜を非磁性基板上に被覆し、（ｂ）その後前記金属からなる連続薄膜を加熱により分離凝集させる、ことにより形成することを特徴とする、表面に凹凸形状を有する磁気記録媒体の製造方法。
【請求項２】前記金属の系がつくる共晶点が５００℃以下である請求項１に記載の表面に凹凸形状を有する磁気記録媒体の製造方法。
【請求項３】前記金属の主成分がＡｌであり、他の成分がＧｅおよびＭｇからなる金属群から選ばれた少なくとも１種であることを特徴とする請求項１または２に記載の表面に凹凸形状を有する磁気記録媒体の製造方法。
【請求項４】前記金属はＡｌとＧｅとからなり、Ｇｅが２０～４０原子％含まれることを特徴とする請求項１乃至３のいずれかの項に記載の表面に凹凸形状を有する磁気記録媒体の製造方法。
【請求項５】前記凹凸形成物を形成するに先立ち、非磁性基板上に非磁性基板の表面エネルギーを減少させる層を設けることを特徴とする請求項１乃至３に記載の表面に凹凸形状を有する磁気記録媒体の製造方法。
【請求項６】前記表面エネルギーを減少させる層をチタニウムとクロムの合金層とすることを特徴とする請求項５に記載の表面に凹凸形状を有する磁気記録媒体の製造方法。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は磁気記録装置に用いられる磁気記録媒体の製造方法に関し、さらに詳述すると磁気ヘッドとの摩擦摺動特性が向上した磁気記録媒体の製造方法に関する。
【０００２】
【従来の技術】現在コンピューター等の記録装置として普及しているハードディスクドライブには，磁気記録媒体（磁気ディスク）の停止時に磁気ヘッドが磁気ディスクに接触し，起動初期に磁気ヘッドが磁気ディスク上を摺動し，そののちに磁気ディスクを離れて浮上し，一定距離で飛行するといういわゆるＣＳＳ（コンタクトースタートーストップ）方式が多く採用されている。このときに磁気ヘッドと磁気ディスクの摩擦係数を下げるために、磁気ディスク表面に微細な凹凸を形成することが行われている。この微細凹凸は摩擦係数を十分に下げると共に、磁気ヘッドは飛行状態にあるとき、この凹凸にぶつからないことが要求される。従来、この微細凹凸の形成には、回転する非磁性基板上に研磨砥粒等を押し当てて円周方向にキズを形成する方法が行われていた。また磁気ヘッドのより低浮上な飛行を要求される磁気ディスクでは、例えば非磁性基板を加熱し、Ａｌ等の低融点金属薄膜を島状構造を形成するように被覆することにより、表面凹凸を形成する方法が提案されている（特開平３－７３４１９号公報）。また、非磁性基板表面上に金属薄膜を形成した後、加熱して微細凝集粒からなる膜にして、表面凹凸を形成する方法が提案されている（特開平５－８５７７３号公報）。さらに融点が３５０℃以下の低融点金属をその融点以上に加熱した基板上に、被覆して液滴状の金属粒子とする方法が提案されている（特開平５－２８２６４８号公報）。
【０００３】
【発明が解決しようとする課題】しかしながら、ガラス、セラミックス等の脆性がなく、硬度の大きな基板では、従来技術の研磨砥粒で円周方向にキズを形成する方法では、基板が欠け易いという問題点があり、またその表面凹凸形状を精密に制御することができず、ＣＳＳ特性と磁気ヘッドの低浮上特性の両方を同時に満たすことは非常に難しいという問題点があった。
【０００４】また、前述した高温に加熱された基板上に島状構造の凹凸形成物を形成する方法では、その表面凹凸の大きさや周期が小さく、また凸部の高さの分布が揃いすぎているために，摩擦係数がそれほど小さくならず、ＣＳＳ特性は必ずしも満足なものではないという問題点があった。またこのような島状構造を形成させるためには成膜時の基板温度をかなり高い温度に保持しなくてはならず，特に生産性の高い基板搬送型の成膜装置においては基板加熱ゾーンから成膜ゾーンに至るまでの基板温度の低下、基板内の温度分布が悪くなるなどの問題点があった。本発明はこのような問題点を解決するためになされたものである。
【０００５】
【課題を解決するための手段】本発明は、保護層表面に凹凸を付与するための凹凸形成物を非磁性基板上に形成し、その後下地層、磁性層、保護層を順次形成して磁気記録媒体を製造する方法において、前記凹凸形成物を、（ａ）共晶点を有する２種以上の金属からなる連続薄膜を非磁性基板上に被覆し、（ｂ）その後前記金属からなる連続薄膜を加熱により分離凝集させる、ことにより形成する表面に凹凸形状を有する磁気記録媒体の製造方法である。
【０００６】本発明は、低い共晶点を有する共晶系の多成分金属の薄膜が、その融点や共晶点近傍またはそれ以上に加熱された場合、その原子間の結合がルーズな溶融状態となり、容易にその形状が変化できる状態で相分離を起こさせ、全体の状態エネルギーの中で界面及び表面エネルギーの割合が大きい平坦な薄膜から、より界面及び表面エネルギーの割合が小さな液滴状に凝集させることを特徴としている。そして、非磁性基板の表面と平行な方向に連続した金属薄膜を加熱する前の初期段階の薄膜は、その膜厚が薄ければ薄いほど，全体の中での界面

及び表面エネルギーの割合が大きいため、溶融状態及び凝集過程は、バルクの状態での融点あるいは共晶点よりかなり低い温度（具体的にはバルクの融点のその絶対温度で１／２～２／３程度の温度）で起こり得る。また、この表面及び界面エネルギーの割合を大きくする観点から，初期の薄膜はいわゆる島状構造とならない連続膜である方が望ましい。このような連続金属膜は、低い基板温度で成膜する、たとえば強制的に加熱しない室温度で成膜することによって得ることができる。

【０００７】用いる金属膜としては、バルク状態での融点が６６０℃であるＡｌを室温のソーダライムガラス基板に５～１０ｎｍほど成膜し、これを４５０℃まで加熱したが、磁気ディスクの表面凹凸を形成するのに必要な表面形状を有する凹凸形成物（テクスチャー）は形成できなかった。これ以上の加熱温度はガラス基板の変形を伴う危険性があり，また基板表面からのガス放出が多くなるため実用生産の観点からして好ましくない。

【０００８】一方、共晶点を有する２成分系または３成分以上の系の合金においては、その共晶点組成近傍であれば，その融点は各成分の金属単体の融点よりもはるかに低くなることはよく知られている。例えばＡｌ、Ｇｅの各単体のバルクでの融点はそれぞれ６６０℃、９３６℃であるが、その共晶点（Ａｌ：Ｇｅ＝７１．６：２８．４、原子％比）では、その融点は４２０℃程度まで低くなる。そこでこのような共晶点近傍の組成を有する各成分が微視的に十分混じり合った、例えば非晶質のような連続膜を形成し，これを加熱すれば溶融、凝集が起きる。そしてこの場合、凝集過程と同時に各共晶系成分の相分離が同時に起きる。

【０００９】合金の共晶点が５００℃以下となるように合金系を選ぶことは、たとえばソーダライムシリカ組成のフロートガラスの非磁性基板が軟化変形しない温度で溶融、凝集を起こさせるので好ましい。なかでも、主成分金属をＡｌとするＡｌ－Ｇｅ、Ａｌ－Ｍｇの２成分系またはそれらを含む多成分系の金属系は、共晶点の温度が５００℃以下であり、しかもそれらの金属の連続膜を加熱することにより生ずる凝集が組成的な相分離を伴って起きるので好ましい。本発明においては、Ａｌを主成分とし、ＧｅまたはＭｇを副成分とする系が好ましく、主成分のＡｌが６０～８０原子%、副成分が２０～４０原子%含む連続膜を被覆するのが好ましい。

【００１０】本発明にかかる連続薄膜の加熱温度は、共晶点の温度である共晶温度よりも１５０℃低い温度よりも高くすることが、短時間に凝集をおこさせる上で好ましい。本発明においては、金属薄膜の厚みを４～２０ｎｍとし、その後加熱により凹凸形成物の高さを２５～１００ｎｍとするのが好ましい。

【００１１】さらに、非磁性基板がガラス基板であるとき、凹凸形成物を形成するに先立ち、凹凸形成物の凝集状態を調整するために、基板の表面エネルギーを減少させる層を設けることができる。かかる表面エネルギーを減少させる層としては、ＴｉやＴｉ－Ｃｒ合金の層が好ましく用いられる。

【００１２】

【作用】本発明にかかる２成分以上の金属からなる基板面方向に連続した金属被膜は、その系の共晶点以上に加熱され冷却されることにより相分離を伴って凝集し、連続膜から離散的に基板上に配置された形状の凹凸形成物になる。この凹凸形成物の表面形状に影響を受けて磁気記録媒体の保護層表面は凹凸が形成される。

【００１３】

【実施例】以下、実施例により本発明を詳細に説明する。図１および図２は本発明の実施例の一部断面図（模式的に表現されている）である。図１は、ガラス基板１上にＡｌとＧｅからなる凹凸形成物２が形成され、その上にＴｉ下地層４、Ｃｒ下地層５、磁性層６、保護層３が形成され、保護層３の表面には凹凸形成物２に基因する凹凸が形成されている。図２は、他の実施例の一部断面図（模式的に表現されている）で、凹凸形成物２をガラス基板上に形成するに先立ち、ガラス基板１上に表面エネルギーを減少させるための層７が形成されている。図３は、本発明にかかる凹凸形成物の形状を説明するための電子顕微鏡写真から得た図である。

【００１４】実施例１

良く洗浄された室温状態のソーダライムシリカ組成のガラス基板（円盤状に加工され化学強化されたもの）１に$Al_{71.6}Ge_{28.4}$（原子%）をスパッタリングターゲットとし、アルゴンを用いたＤＣマグネトロンスパッタ法によりＡｌＧｅ膜２を約１０ｎｍ成膜した。次に同じ真空槽内でこの基板を３５０℃に保持されたヒーター直前に３分間保持したのち外部に取りだした。得られた基板表面を走査型電子顕微鏡で観察した。その表面形状を模式的に図３に示す。ガラス基板表面（図３中Ｂで示される）上に加熱により島状に分離したＡｌＧｅ膜（図３中Ａで示される）が被覆されており、島状に分離したＡｌＧｅ膜の周縁部に径約２００ｎｍ高さ約５０ｎｍの大きさの十分に離散した液滴状凝集体が形成されていた。

【００１５】実施例２

良く洗浄された室温状態のソーダライムシリカ組成のガラス基板（円盤状に加工された化学強化されたもの）１に$Al_{71.6}Ge_{28.4}$（原子%）をスパッタリングターゲットとし，アルゴンガスを用いＤＣスパッタリング法によりＡｌＧｅ膜２を約５ｎｍ成膜した。次に同じ真空槽内でこの基板を３５０℃に保持されたヒーター前に３分間保持し，この後Ｔｉ膜を同様な方法でチタンターゲットを用いて３０ｎｍ成膜し，さらに３５０℃に保持されたヒーター前に３分間保持し，この後，Ｃｒ膜，ＣｏＮｉＣｒ膜，カーボン膜をそれぞれ１２０ｎｍ、５６ｎｍ、２０ｎｍの厚さに、クロム、コバルトニッケルクロム合金、カーボンをターゲットに用いて順次成膜した.

以上のプロセスはすべて同一の真空槽内で真空を破らずに行った．次にこの基板を取り出し，液体潤滑剤を約３ｎｍ塗布し，磁気ディスクを得た。この磁気ディスクの断面構造の模式図を図２に示す。この磁気ディスクの表面凹凸を走査トンネル顕微鏡で測定したところ，その平均粗さで約４．５ｎｍ程度となっており，上で述べたような膜構成で、ただＡｌＧｅ膜を形成しなかった場合の値（２．０ｎｍ）に比べ、確実に表面凹凸が形成されていることが確認された．次に磁気ヘッドのこの磁気ディスク上での浮上特性を調べたところ，６２ｎｍまでは磁気ヘッドが磁気ディスク上の突起物に衝突することなく安定に浮上走行することがわかった．最後にこの磁気ディスクをヘッド荷重を６．５ｇとしたマイクロスライダーを用いてＣＳＳ試験にかけたところ，２万回での静止摩擦係数が０．６，動摩擦係数０．５程度ときわめて良好な摩擦摺動特性を示した。

【００１６】実施例３

良く洗浄されたソーダライムシリカ組成のガラス基板上に４５原子％のＣｒを含むＴｉ膜を２０ｎｍ，その上に連続して１０ｎｍの$Al_{71.6}Ge_{28.4}$をＤＣマグネトロンスパッタ法で形成した．次にこの基板を３００℃に保持されたヒーター前に３分間保持し，この後Ｔｉ膜を同様な方法で約３０ｎｍ成膜し，さらに３５０℃に保持されたヒーター前に３分間保持し，この後，Ｃｒ膜，ＣｏＮｉＣｒ膜，カーボン膜をそれぞれ１２０ｎｍ、５６ｎｍ、２０ｎｍの厚さで順次成膜した。以上のプロセスは、すべて同一の真空槽内で真空を破らずに行った．次にこの基板を取り出し，液体潤滑剤を約３ｎｍ塗布し，磁気ディスクを得た。この磁気ディスクの一部断面図を図３に示す。この磁気ディスクの表面凹凸を走査トンネル顕微鏡で測定したところ、その平均粗さで約６．０ｎｍとなっていた。次に磁気ヘッドのこの基板上での浮上特性を調べたところ，７０ｎｍまでは磁気ヘッドが磁気ディスク上の突起物に衝突することなく安定に浮上走行することがわかった。最後にこの磁気ディスクをヘッド荷重を６．５ｇとしたマイクロスライダーを用いてＣＳＳ試験にかけたところ、２万回での静止摩擦係数が０．４，動摩擦係数０．３程度ときわめて良好な摩擦摺動特性を示した。

【００１７】実施例４

良く洗浄された室温状態のソーダライムシリカ組成のガラス基板（円盤状に加工された化学強化されたもの）に$Al_{33}Zn_{67}$（原子％）をスパッタリングターゲットとし，アルゴンガスを用いたＤＣマグネトロンスパッタ法によりＡｌＺｎ膜を約５ｎｍ成膜した。次に同じ真空槽内でこの基板を３５０℃に保持されたヒーター前に３分間保持し，この後Ｔｉ膜を同様な方法で約３０ｎｍ成膜し，さらに３５０℃に保持されたヒーター前に３分間保持し，この後，Ｃｒ膜，ＣｏＮｉＣｒ膜，カーボン膜をそれぞれ１２０ｎｍ、５６ｎｍ、２０ｎｍの厚さで順次成膜した．以上のプロセスはすべて同一の真空槽内で真空を破らずに行った．次にこの基板を取り出し，液体潤滑剤を約３ｎｍ塗布し，磁気ディスクを得た。この磁気ディスクの表面凹凸を走査トンネル顕微鏡で測定したところ，その平均粗さで約４．５ｎｍとなっており，確実に表面凹凸が形成されていることが確認された．次に磁気ヘッドのこの基板上での浮上特性を調べたところ，５０ｎｍまでは磁気ヘッドが磁気ディスク上の突起物に衝突することなく安定に浮上走行することがわかった．最後にこの磁気ディスクをヘッド荷重を６．５ｇとしたマイクロスライダーを用いてＣＳＳ試験にかけたところ，２万回での静止摩擦係数が０．７，動摩擦係数０．６程度ときわめて良好な摩擦摺動特性を示した．

【発明の効果】本発明によれば、磁気ヘッドとの摩擦摺動特性及び低浮上特性に優れた磁気記録媒体を得るのに必要な磁気記録媒体の表面の凹凸形状を、非磁性基板表面に薄膜形成及び加熱というプロセスにより，その後に行う下地層、磁性層、保護層の形成と連続して行うことができる。

【図面の簡単な説明】

【図１】本発明により得られた磁気ディスクの一実施例の一部断面図である。

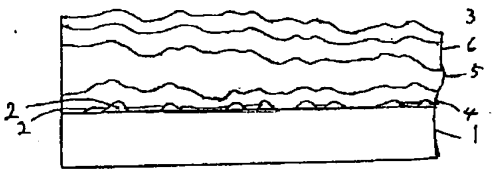
【図２】本発明により得られた磁気ディスクの他の実施例の一部断面図である。

【図３】本発明の実施例１のＡｌ－Ｇｅ系凹凸組成物の表面形状を説明するために走査型電子顕微鏡写真から得た図である。

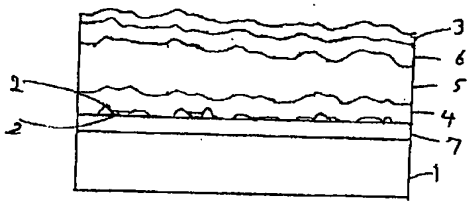
【符号の説明】

１・・・ガラス基板、２・・・凹凸形成物、３・・・保護層、４・・・Ｔｉ層、５・・・下地層、６・・・磁性層、７・・・表面エネルギーを減少させる層

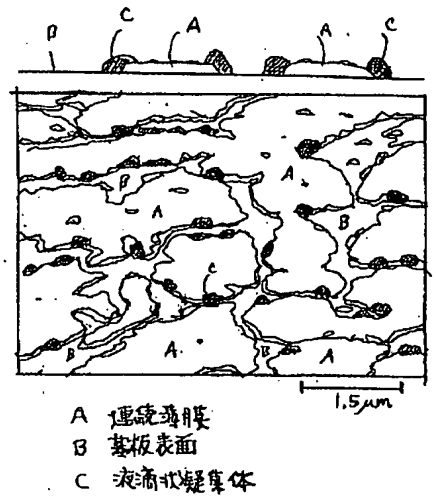
【図１】



【図２】



【図３】



A 連続薄膜
B 基板表面
C 液滴状凝集体

【手続補正書】
【提出日】平成６年３月１８日
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】００１７
【補正方法】変更
【補正内容】
【００１７】　実施例４
良く洗浄された室温状態のソーダライムシリカ組成のガラス基板（円盤状に加工された化学強化されたもの）にＡｌ$_{60}$Ｍｇ$_{40}$（原子%）をスパッタリングターゲットとし，アルゴンガスを用いたＤＣマグネトロンスパッタ法によりＡｌＭｇ膜を約５ｎｍ成膜した。次に同じ真空槽内でこの基板を３５０℃に保持されたヒーター前に３分間保持し，この後Ｔｉ膜を同様な方法で約３０ｎｍ成膜し，さらに３５０℃に保持されたヒーター前に３分間保持し，この後，Ｃｒ膜，ＣｏＮｉＣｒ膜，カーボン膜をそれぞれ１２０ｎｍ、５６ｎｍ、２０ｎｍの厚さで順次成膜した．以上のプロセスはすべて同一の真空槽内で真空を破らずに行った．次にこの基板を取り出し，液体潤滑剤を約３ｎｍ塗布し，磁気ディスクを得た。この磁気ディスクの表面凹凸を走査トンネル顕微鏡で測定したところ，その平均粗さで約４．５ｎｍとなっており，確実に表面凹凸が形成されていることが確認された．次に磁気ヘッドのこの基板上での浮上特性を調べたところ，５０ｎｍまでは磁気ヘッドが磁気ディスク上の突起物に衝突することなく安定に浮上走行することがわかった．最後にこの磁気ディスクをヘッド荷重を６．５ｇとしたマイクロスライダーを用いてＣＳＳ試験にかけたところ，２万回での静止摩擦係数が０．７，動摩擦係数０．６程度ときわめて良好な摩擦摺動特性を示した。